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(54) ELECTROPHYSIOLOGY CATHETER WITH PRE-CURVED TIP

ELEKTROPHYSIOLOGIEKATHETER MIT VORGEBOGENER SPITZE

CATHETER D'ELECTROPHYSIOLOGIE A POINTE PRE-COURBEE

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Description

[0001] This invention relates to elongate electrode catheters.

[0002] Millions of people suffer from abnormally high heart beat rhythm, a condition referred to as "tachycardia". One type of tachycardia is right sided supra-ventricular tachycardia (SVT). This condition is caused by a conducting pathway between the right atrium at the right ventricle across the tricuspid annulus. With right sided supra-ventricular tachycarida, the atria typically beats too rapidly. Symptoms of right sided supra-ventricular tachycardia include chest pain, fatigue and dizziness.

[0003] Radiofrequency (RF) catheter ablation has been found to be a safe and efficacious means of interrupting accessory electrical pathways which result in tachycarida. In such a procedure, a special electrophysiology catheter is guided through a vein into the patient's heart and to the site of the accessory pathway. The catheter is designed to transmit energy from an external source into the accessory pathway in an amount sufficient to ablate the tissue. The ablated tissue is replaced with scar tissue which interrupts the accessory pathway. The normal conduction of electroactivity is thereby restored.

[0004] Before an RF catheter ablation procedure can be utilized, the site of the accessory pathway must be determined. This is accomplished with a diagnostic or mapping catheter which typically comprises multiple electrodes for stimulating and sensing electrical activity. In, general, this procedure involves introducing a mapping catheter into the patient's heart and into the chamber where the arrhythmia condition exists. The tissue is stimulated in a manner intended to induce the arrhythmia and expose the abnormal electrical conduction. The resulting information regarding the number and locations of aberrant sites identified and the severity of the abnormality enables the electrophysiologistis to determine the appropriate course of treatment. Electrophysiologic evaluation generally involves multiple tests to diagnose the arrhythmia and to assess the potential effectiveness of various treatment strategies.

[0005] One procedure for determining the site of right sided supra-ventricular tachycarida is to introduce a mapping catheter into the right coronary artery which extends about the right atrium at about the location of the tricuspid annulus. This procedure is very dangerous and accordingly not favoured. Another known procedure is to introduce a deflectable tip mapping catheter into the right atrium and, by manipulation of the catheter, to move the catheter about, particularly around the tricuspid annulus until the accessory pathway is located. This is a time-consuming and cumbersome approach.

[0006] An improvement in mapping the right sided supra-ventricular pathways has been the use of a multiple electrode catheter having a generally circular precurved tip portion. Such a catheter is advanced from the femoral vein by Seldinger technique into the right atrium. The distal end of the tip portion is maneuvered into the coronary sinus (CS) ostium and the remainder of the circular tip portion is maneuvered into the region of the triscuspid annulus. Through the use of multiple electrodes around the circular tip portion, the time required to map the right sided supra-ventricular pathways is greatly reduced.

[0007] While the use of a generally circular tip portion has greatly improved the efficiency of the mapping procedure for right sided supra-ventricular pathways, there are still some difficulties associated with this procedure. First, the circular tip portion of the catheter is difficult to maneuver. Secondly, the diameter of the generally circular tip portion is fixed and therefore cannot be adjusted to accommodate artial chambers of varying sizes. The catheter tip is also difficult to maneuver, particularly being difficult to anchor the distal end of the tip portion in the CS ostium.

[0008] According to the present invention there is provided an elongate electrode catheter comprising: an elongate flexible tubular catheter body having an axis and proximal and distal ends; a tubular tip portion at the distal end of the tubular body including a performed generally circular curve lying in a cylindrically shaped region transverse to the axis of the catheter body, said tip portion having proximal and distal ends and carrying a plurality of spaced apart electrodes; an electrode lead wire associated with each electrode, said electrode lead wire having proximal and distal ends and extending through the catheter body and into the catheter tip portion, the distal end of the electrode lead wire being electrically connected to its associated electrode; a puller wire having proximal and distal ends extending through the tubular body and into the tip portion, the distal end of the puller wire being fixedly attached to about the distal end of the tip portion, whereby longitudinal movement of the puller wire relative to the tubular body results in contraction of the generally circular curve of the tip portion; and handle means connected to the proximal ends of the catheter body and puller wire for moving the puller wire longitudinally relative to the catheter body to thereby control the curvature of the tip portion.

[0009] According to the present invention there is further provided an elongate electrode catheter comprising: an elongate flexible tubular catheter body having an axis and proximal and distal ends; a tubular tip portion at the distal end of the tubular body comprising a preformed compound curve consisting essentially of a first bend away from a plane containing the axis of the catheter body and a second bend forming a generally circular curve lying generally in a plane transverse to the axis of the catheter body, said tip portion having proximal and distal ends and carrying a plurality of spaced apart electrodes; an electrode lead wire associated with each electrode, said electrode lead wire having proximal and distal ends and extending through the catheter body and into the catheter tip portion, the distal end of the elec-

trode lead wire being electrically connected to its associated electrode; a puller wire having proximal and distal ends extending through the tubular body and into the tip portion, the distal end of the puller wire being fixedly attached to about the distal end of the tip portion, whereby longitudinal movement of the puller wire relative to the tubular body results in contraction of the generally circular curve of the tip portion; and handle means connected to the proximal ends of the catheter body and puller wire for moving the puller wire longitudinally relative to the catheter body to thereby control the diameter of the generally circular curve of the tip portion.

[0010] The embodiments described hereinafter comprise an improved electrode mapping catheter particularly suitable for mapping right sided supra-ventricular accessory electrical pathways in the heart. The catheter comprises an elongate, flexible tubular body having proximal and distal ends. The wall of the catheter body is preferably reinforced with one or more layers, reinforcing, eg layers of braided stainless steel mesh.

[0011] Extending from the distal end of the catheter body is a tubular tip portion. The tip portion comprises a generally circular curve transverse to the axis of the catheter body. In a preferred embodiment, the tip portion comprises a compound curve including a first bend of about 30° to the catheter body axis and then a generally circular curve lying in a plane about 30° to the catheter body axis.

[0012] A puller wire extends through the catheter body and into the tip portion. The distal end of the puller wire is fixedly attached to the wall of the tip portion adjacent the distal end of the tip portion. The proximal end of the puller wire is connected to a handle which provides means for moving the puller wire longitudinally relative to the catheter body. Movement of the puller wire proximally relative to the catheter body results in a decrease in the diameter of the generally circular section of the tip portion and increase in the angle of the plane of the circular tip portion to the axis of the catheter body to more than 30°.

[0013] The section of the tip portion comprising the generally circular curve carries a plurality of electrodes spaced apart from each other. An electrode lead wire is connected at its distal end to each electrode and extends through the interior of the tip portion and catheter body. At their proximal ends, the electrode lead wires terminate in a suitable connector for connection with a stimulator and/or recorder.

[0014] An elongate electrode catheter embodying the present invention, will now be described, by way of example, with reference to the accompanying diagrammatic drawings, in which:

Figure 1 is an external view of a preferred electrode catheter constructed in accordance with the present invention;

Figure 2 is an enlarged end view of the catheter tip portion;

Figure 3 is an enlarged end view of another embodiment showing the catheter tip portion of another embodiment of the invention;

Figure 4 is a side view of the tip portion of the catheter of Figure 1;

Figure 5 is a side view of the tip portion shown in Figure 4; after the puller wire has been removed longitudinally proximally with respect to the catheter body;

Figure 6 is a fragmentary enlarged view of a portion of the tip portion showing an electrode pair;

Figure 7 is a cut-away view of a heart showing the positioning of the tip portion about the annulus of the tricuspid valve;

Figure 8 is a preferred form used in the formation of the compound curve of the tip portion; and

Figure 9 is an enlarged cross-sectional view of the distal end of the tip portion.

[0015] Figures 1 and 2 illustrate a preferred electrode catheter constructed in accordance with the present invention. The electrode catheter 10 comprises an elongate catheter body 11 having proximal and distal ends, a catheter tip portion 12 having a generally circular curve transverse, ie at an angle to the axis of the catheter body 11 at the distal end of the catheter body 11, and a control handle 13 at the proximal end of the catheter body 11.

[0016] The catheter body 11 comprises an elongated tube having a lumen 15. The catheter body 11 is flexible, ie bendable, but substantially non-compressible along its length. The catheter body 11 may be of any suitable construction and made of any suitable material. A presently preferred construction comprises a nylon tube surrounded by one or more reinforcing layer of braided stainless steel or the like with a polyurethane coating.

[0017] The length and diameter of the catheter body 11 are not critical. For the electrode catheter shown in the accompanying drawing, a length of about 102 to 122 cm (40 to 48 inches), an outer diameter of about 2.5 mm (0.1 inch) (8 French), and an inner diameter, ie lumen diameter, of about 0.76 to 1.02 mm (0.03 to about 0.04 inches) is presently preferred.

[0018] The catheter tip portion 12 comprises a short length, eg 20.3 cm (8 inches) in length and diameter size of 3.3 mm (6½ French), of flexible tubing having a lumen 16. The tip portion 12 is formed in a compound curve comprising a first section 17 forming a bend of preferably about 30°, and a second section 18 forming a generally circular curve. Such a compound curve results in the generally circular curve lying generally in a plane transverse to, and preferably about 30° to, the axis of catheter body 11.

[0019] As used herein, a "generally circular curve" is meant to include curves which are in and out of a simple plane, spirals, helices, non-circular loops and the like. Such curves may form a full 360° circle or more, but may also be less than a full circle. It is preferred that such curves form at least a semi-circle, ie a 180° curve and

particularly preferred that the generally circular curve form a full circle, ie 360°.

[0020] The generally circular curve of the tip portion 12 may be positioned relative to the axis of the catheter body 11 so that the axis A of the catheter body 11 lies on the perimeter of the generally circular curve as shown in Figure 2 or at any point within the generally circular curve, for example as shown in Figure 3.

[0021] The tubular wall of the tip portion 12, may be made of any suitable material. It is more compressible and preferably, more flexible, ie bendable, than the catheter body 11. A presently preferred construction for the catheter tip portion 12 comprises a thermoplastic resin, eg polyurethyane, reinforced with a DACRON (Registered Trade Mark) braid. The diameter of the catheter tip portion 12 is not critical, but is preferably about the same as or slightly smaller than the diameter of the catheter body 11.

[0022] The compound curve of the catheter tip portion 12 can be formed by any suitable process. In a preferred embodiment, the tubular wall of the tip portion comprises a thermoplastic resin. The catheter is first constructed, eg mounting or formation of the electrodes, attachment of the puller wire, etc without the compound curve in the tip portion, ie with the tip portion being straight. The tip portion is then inserted into a tubular, generally rigid form 40 as shown in Figure 8. The form 40 which may be made of any suitable material, eg nylon, has the shape of the desired compound curve. The tip portion of the catheter and the holder are then heated to a temperature sufficient for the tip portion to acquire the shape of the form 40 and to retain that shape when cooled. The form 40 can also be used to contain the tip portion 12 when the catheter is not in use to present damage or stress to the tip portion 12.

[0023] Along the length of the generally circular section 18 of the tip portion 12, there are a plurality of electrodes 21. The electrodes maybe single electrodes or electrode pairs. The electrodes 21 may be in the form of metal rings, the outer diameter of the electrodes 21 being about the same as the outer diameter of the flexible tubing of the tip portion 12 so that the electrodes 21 form a smooth, continuous surface with the outer surface of the flexible tubing. Electrode lead wires 22 having an insulation coating extend from the electrodes 21 through the lumen 16 and 15 of the catheter tip portion 12 and the catheter body 11 and the handle is electrically connected to molded multi-pin connectors 23. The connectors 23 may be plugged directly into a stimulator/recorder or other electrical device or connected to the female end to a floating extension cable which in turn has connectors at its opposite end which can be plugged into the electrical device. It is apparent that the lead wires may be connected to a rotary plug or to individual tip pins if desired.

[0024] Alternatively, the electrodes 21 may be formed by passing the electrode lead wires 22 through the wall of the catheter tip portion 12 at separate locations and wrapping the lead wires 22 around the tubing as shown in Figure 4. The wrapped wires are secured to the wall of the tip portion by adhesive or other suitable means. The insulation coating of the lead wires 22 is stripped off those portions of the wrapped wires which will contact the heart well. Such a construction is described in US Patent Application No 5,411,025: (formerly Application Serial No 07/906,546, filed June 30, 1992, published after the filing date of the present application).

[0025] In the embodiment shown, the catheter tip portion 12 carries ten wound electrode pairs 21. Three platinum locator rings or makers 25 are placed equidistant between the fifth and sixth electrode pairs and bordering each end of the electrode array. The marker 25 can be easily distinguished from the electrode pairs under fluoroscopy. This enables identification of the position of each electrode during a mapping procedure. It is understood that the number of electrodes vary as required. The number, location and even presence of a marker or makers is optional.

[0026] A puller wire 30, preferably made of stainless steel, extends from the control hand 13 through the lumen 15 of the catheter body 11 and into the lumen 16 of the catheter tip portion 12. In the embodiment shown, the puller wire 30 extends through the lumen 16 of the catheter tip portion 12 and is fixedly attached to the distal tip of the tip portion 12. A preferred anchor means for attaching the puller wire 30 to the catheter tip portion 12 is described in US Patent No 4,960,134.

[0027] With reference to Figure 9, there is shown a presently preferred method of attachment. An anchor 41 is fixedly attached, eg crimped to the distal end of the puller wire 30. The anchor 41 is then wedged against the tip portion wall and secured at the distal tip of the tip portion by means of plug 42 which is fixed, eg glued, in place. The plug 42 and any exposed edges of the anchor 41 are preferably covered with a suitable resin material 43, or the like, to form a rounded distal tip.

[0028] Any suitable control handle 13 which can control longitudinal movement of the puller wire 30 relative to the catheter body 11 may be used. A preferred control handle 13, as shown in Figure 1, is described in US Patent No 4,960,134.

[0029] Movement of the puller wire 30 rearwardly or proximally relative to the catheter body 11 by manipulation of the control handle 13 results in a tightening of the compound curve of the tip portion 12. Specifically, the bend in the first section of the tip portion 12 becomes more acute and the diameter of the generally circular curve of the second section of the tip portion 12 decreases. Figure 4 shows the catheter tip portion 12 in its normal state, ie before the puller wire 30 is moved proximally relative to the catheter body 11. Figure 5 shows the effect on the tip portion 12 of moving the pulling wire 30 proximally relative to the catheter body 11.

[0030] In use, the catheter 10 is preferably inserted into the femoral vein by conventional technique and is advanced through the inferior vena cava 31 into the right

atrium 32. The distal end of the tip portion of the catheter is maneuvered into the coronary sinus ostium 35 and the generally circular section of the tip portion is maneuvered so as the lie about the periphery of the tricuspid valve 36. Heretofore, such maneuvering has been difficult and time consuming. The ability to adjust the diameter of the generally circular section of the tip portion greatly enhances the ability to accomplish the desired maneuvers. It also allows the generally circularly section of the tip portion to be adjusted to better fit the varying sizes of heart patients.

Claims

1. An elongate electrode catheter (10) comprising:

an elongate flexible tubular catheter body (11) having an axis and proximal and distal ends;
a tubular tip portion (12) at the distal end of the tubular body (11) including a performed generally circular curve, said tip portion (12) having proximal and distal ends and carrying a plurality of spaced apart electrodes (21);
an electrode lead wire (22) associated with each electrode (21), said electrode lead wire (22) having proximal and distal ends and extending through the catheter body (11) and into the catheter tip portion (12), the distal end of the electrode lead wire (22) being electrically connected to its associated electrode (21);
a puller wire (30) having proximal and distal ends extending through the tubular body (11) and into the tip portion (12), the distal end of the puller wire (30) being fixedly attached to about the distal end of the tip portion (12), whereby longitudinal movement of the puller wire (30) relative to the tubular body (11) results in contraction of the generally circular curve of the tip portion; and
handle means (13) connected to the proximal ends of the catheter body (11) and puller wire (30) for moving the puller wire (30) longitudinally relative to the catheter body (11) to thereby control the curvature of the tip portion,

characterized by the preformed generally circular curve lying in a cylindrically shaped region transverse to the axis of the catheter body (11).

2. An electrode catheter according to Claim 1, **characterised in that** the cylindrically shaped region of the generally circular curve of the tip portion extends at an angle of substantially 30° to the axis of the tubular catheter body (11).

3. An elongate electrode catheter (10) comprising:

an elongate flexible tubular catheter body (11) having an axis and proximal and distal ends;
a tubular tip portion (12) at the distal end of the tubular body (11) comprising a preformed curve, said tip portion (12) having proximal and distal ends and carrying a plurality of spaced apart electrodes (21);
an electrode lead wire (22) associated with each electrode (21), said electrode lead wire (22) having proximal and distal ends and extending through the catheter body (11) and into the catheter tip portion (12), the distal end of the electrode lead wire (22) being electrically connected to its associated electrode (21);
a puller wire (30) having proximal and distal ends extending through the tubular body (11) and into the tip portion (12), the distal end of the puller wire (30) being fixedly attached to about the distal end of the tip portion (12), whereby longitudinal movement of the puller wire (30) relative to the tubular body (11) results in contraction of the generally circular curve of the tip portion (12); and
handle means (13) connected to the proximal ends of the catheter body (11) and puller wire (30) for moving the puller wire (30) longitudinally relative to the catheter body (11) to thereby control the diameter of the generally circular curve of the tip portion (12),

characterized by the preformed curve being compound and consisting essentially of a first bend away from a plane containing the axis of the catheter body (11) and a second bend forming a generally circular curve lying generally in a plane transverse to the axis of the catheter body.

4. An electrode catheter according to Claim 1, **characterised in that** the first bend portion extends at an angle of substantially 30°.

Patentansprüche

1. Langgestreckter Elektrodenkatheter (10), mit einem langgestreckten flexiblen rohrförmigen Katheterkörper (11), der eine Achse und ein proximales und ein distales Ende aufweist, mit einem rohrförmigen Kopfteil (12) mit vorgeformter im Wesentlichen kreisförmiger Rundung am distalen Ende des rohrförmigen Körpers (11), wobei der Kopfteil (12) das proximale und das distale Ende aufweist und eine Vielzahl beabstandeter Elektroden (21) trägt, mit einem Elektrodenleitungsdraht (22), der jeder Elektrode (21) zugeordnet ist, wobei der Elektrodenleitungsdraht (22) ein proximales und ein distales Ende besitzt und sich durch den Katheterkörper (11) und in den Katheterkopfteil (12) erstreckt und

wobei das distale Ende des Elektrodenleitungsdrahtes (22) mit dessen zugeordneter Elektrode (22) elektrisch verbunden ist, mit einem ein proximales und ein distales Ende besitzenden Zugdraht (30), der sich durch den rohrförmigen Körper (11) und in den Kopfteil (12) erstreckt, wobei das distale Ende des Zugdrahtes (30) etwa mit dem distalen Ende des Kopfteils (12) fest verbunden ist, wodurch eine Längsbewegung des Zugdrahtes (30) relativ zum rohrförmigen Körper (11) in einer Kontraktion der im Wesentlichen kreisförmigen Rundung des Kopfteils resultiert, und mit Handhabungsmitteln (13), die mit den proximalen Enden von Katheterkörper (11) und Zugdraht (30) zum längsgerichteten Bewegen des Zugdrahtes (30) gegenüber dem Katheterkörper (11) verbunden sind, um dadurch die Krümmung des Kopfteils zu steuern, **dadurch gekennzeichnet, dass** die vorgeformte im Wesentlichen kreisförmige Rundung in einem zylindrisch geformten Bereich quer zur Achse des Katheterkörpers (11) liegt.

2. Elektrodenkatheter nach Anspruch 1, **dadurch gekennzeichnet, dass** der zylindrisch geformte Bereich der im Wesentlichen kreisförmigen Rundung des Kopfteils sich in einem Winkel von im Wesentlichen 30° zur Achse des rohrförmigen Katheterkörpers (11) erstreckt.

3. Langgestreckter Elektrodenkatheter (10), mit einem langgestreckten flexiblen rohrförmigen Katheterkörper (11), der eine Achse und ein proximales und ein distales Ende aufweist, mit einem rohrförmigen Kopfteil (12) mit einer vorgemformten Rundung am distalen Ende des rohrförmigen Körpers (11), wobei der Kopfteil (12) ein proximales und ein distales Ende besitzt und eine Vielzahl beabstandeter Elektroden (21) trägt, mit einem Elektrodenleitungsdraht (22), der jeder Elektrode (21) zugeordnet ist, wobei der Elektrodenleitungsdraht (22) ein proximales und ein distales Ende besitzt und sich durch den Katheterkörper (11) hindurch und in den Katheterkopfteil (12) erstreckt, wobei das distale Ende des Elektrodenleitungsdrahtes (22) mit dessen zugeordneter Elektrode (21) elektrisch verbunden ist, mit einem ein proximales und distales Ende aufweisenden Zugdraht (30), der sich durch den rohrförmigen Körper (11) und in den Kopfteil (12) erstreckt, wobei das distale Ende des Zugdrahtes (30) etwa mit dem distalen Ende des Kopfteils (12) fest verbunden ist, wodurch eine Längsbewegung des Zugdrahtes (30) relativ zum rohrförmigen Körper (11) in einer Kontraktion der im Wesentlichen kreisförmigen Rundung des Kopfteils (12) resultiert, und mit Handhabungsmitteln (13), die mit den proximalen Enden von Katheterkörper (11) und Zugdraht (30) zum längsgerichteten Bewegen des Zugdrahtes (30) gegenüber dem Katheterkörper (11) verbunden sind, um dadurch den Durchmesser der im Wesentlichen kreisförmigen Rundung des Kopfteils (12) zu steuern, **dadurch gekennzeichnet, dass** die vorgeformte Rundung zusammengesetzt ist und im Wesentlichen aus einer ersten Biegung weg von einer Ebene, die die Achse des Katheterkörpers (11) enthält, und eine zweite Biegung, die eine im Wesentlichen kreisförmige Rundung bildet, besteht und im Wesentlichen in einer Ebene quer zur Achse des Katheterkörpers liegt.

4. Elektrodenkatheter nach Anspruch 3, **dadurch gekennzeichnet, dass** der erste Biegebereich sich in einem Winkel von im Wesentlichen 30° erstreckt.

Revendications

1. Cathéter allongé à électrodes (10) comprenant :

   un corps de cathéter tubulaire flexible allongé (11) possédant un axe, une extrémité proximale et une extrémité distale ;
   une partie de pointe tubulaire (12) à l'extrémité distale du corps tubulaire (11) incluant une courbe généralement circulaire préformée, ladite partie de pointe (12) possédant une extrémité proximale et une extrémité distale et portant une pluralité d'électrodes espacées (21) ;
   un fil conducteur d'électrode (22) associé à chaque électrode (21), ledit fil conducteur d'électrode (22) possédant une extrémité proximale et une extrémité distale, et s'étendant à travers le corps de cathéter (11) et dans la partie de pointe du cathéter (12), l'extrémité distale du fil conducteur d'électrode (22) étant connectée électriquement à son électrode associée (21) ;
   un fil de tirage (30) possédant une extrémité proximale et une extrémité distale, s'étendant à travers le corps tubulaire (11) et dans la partie de pointe (12), l'extrémité distale du fil de tirage (30) étant fixée à l'extrémité distale de la partie de pointe (12), grâce à quoi le mouvement longitudinal du fil de tirage (30) par rapport au corps tubulaire (11) résulte en la contraction de la courbe généralement circulaire de la partie de pointe ; et
   un moyen de manipulation (13) relié aux extrémités proximales du corps de cathéter (11) et du fil de tirage (30) pour déplacer le fil de tirage (30) longitudinalement par rapport au corps de cathéter (11) afin de régler la courbe de la partie de pointe, **caractérisé par le fait que** la courbe généralement circulaire s'étend dans une région de forme cylindrique transversale par rapport à l'axe du corps de cathéter (11).

2. Cathéter à électrodes selon la revendication 1, **caractérisé en ce que** la région de forme cylindrique de la courbe généralement circulaire de la partie de pointe s'étend selon un angle d'environ 30° par rapport à l'axe du corps de cathéter tubulaire (11).

3. Cathéter allongé à électrodes (10) comprenant :

un corps de cathéter tubulaire flexible allongé (11) possédant un axe, une extrémité proximale et une extrémité distale ;
une partie de pointe tubulaire (12) à l'extrémité distale du corps tubulaire (11) comprenant une courbe préformée, ladite partie de pointe (12) possédant une extrémité proximale et une extrémité distale et portant une pluralité d'électrodes espacées (21) ;
un fil conducteur d'électrode (22) associé à chaque électrode (21), ledit fil conducteur d'électrode (22) possédant une extrémité proximale et une extrémité distale, et s'étendant à travers le corps de cathéter (11) et dans la partie de pointe du cathéter (12), l'extrémité distale du fil conducteur d'électrode (22) étant connectée électriquement à son électrode associée (21) ;
un fil de tirage (30) possédant une extrémité proximale et une extrémité distale s'étendant à travers le corps tubulaire (11) et dans la partie de pointe (12), l'extrémité distale du fil de tirage (30) étant fixée à l'extrémité distale de la partie de pointe (12), grâce à quoi le mouvement longitudinal du fil de tirage (30) par rapport au corps tubulaire (11) résulte en la contraction de la courbe généralement circulaire de la partie de pointe ; et
un moyen de manipulation (13) relié aux extrémités proximales du corps de cathéter (11) et du fil de tirage (30) pour déplacer le fil de tirage (30) longitudinalement par rapport au corps de cathéter (11) afin de régler le diamètre de la courbe généralement circulaire de la partie de pointe (12), **caractérisé par le fait que** la courbe préformée est une courbe composée, qui consiste essentiellement en une première courbure s'éloignant d'un plan contenant l'axe du corps de cathéter (11) et une seconde courbure formant une courbe généralement circulaire s'étend généralement dans un plan qui est transversal par rapport à l'axe du corps de cathéter.

4. Cathéter à électrodes selon la revendication 1, **caractérisé en ce que** la partie de première courbure s'étend selon un angle d'environ 30°.

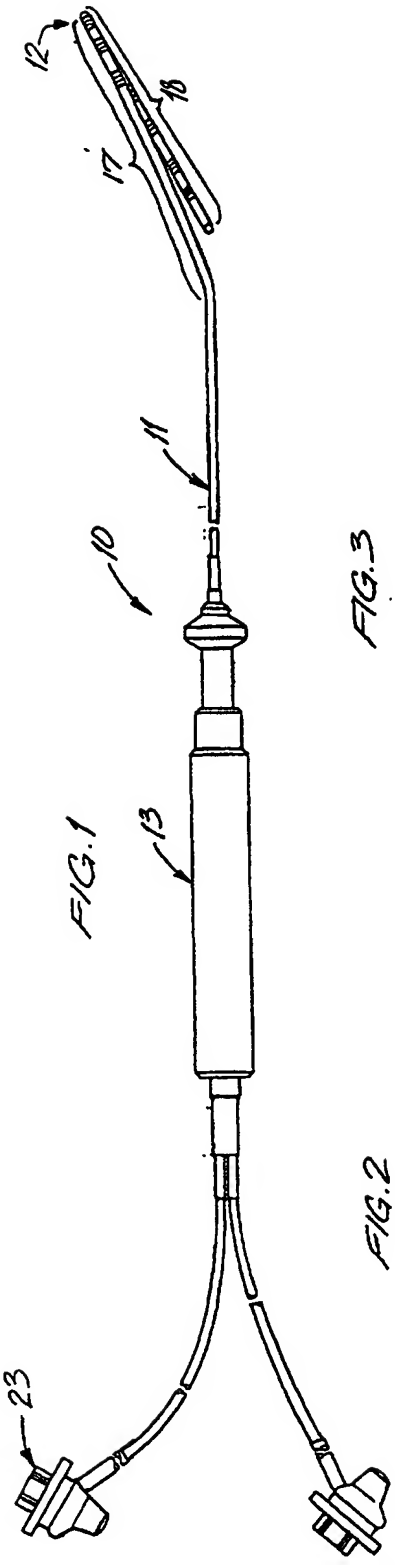


FIG.1

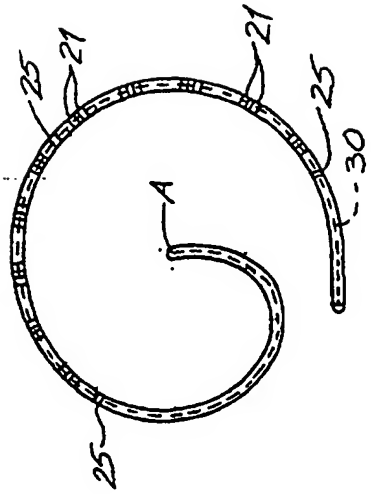


FIG.3

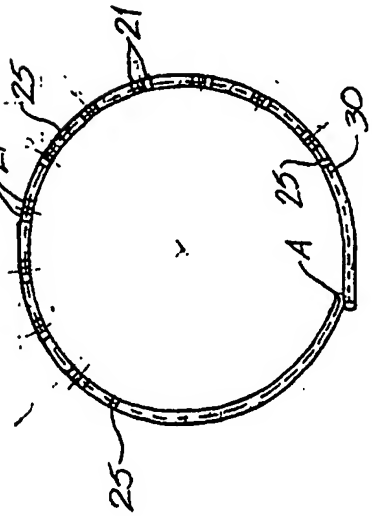


FIG.2

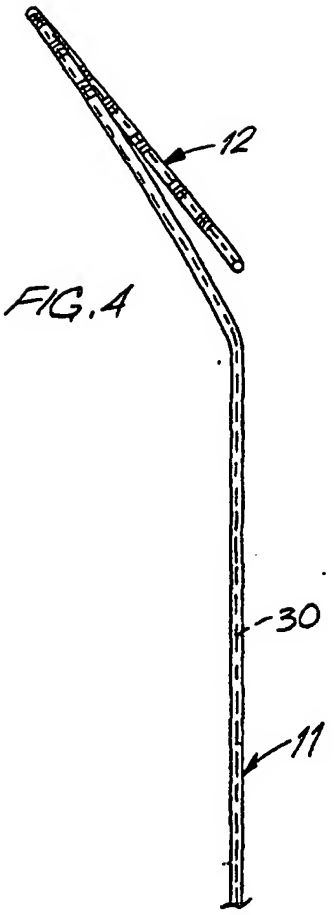


FIG.4

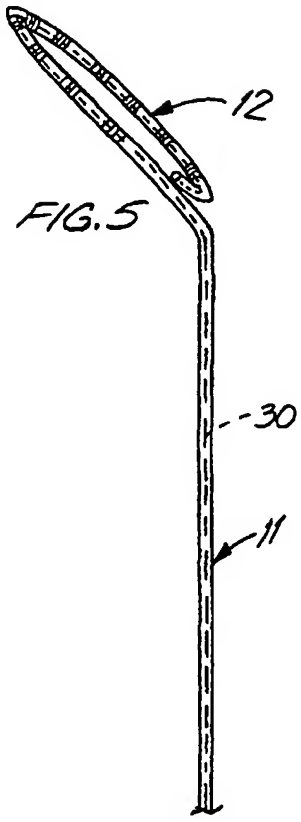


FIG.5

FIG.6

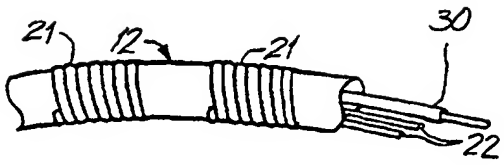
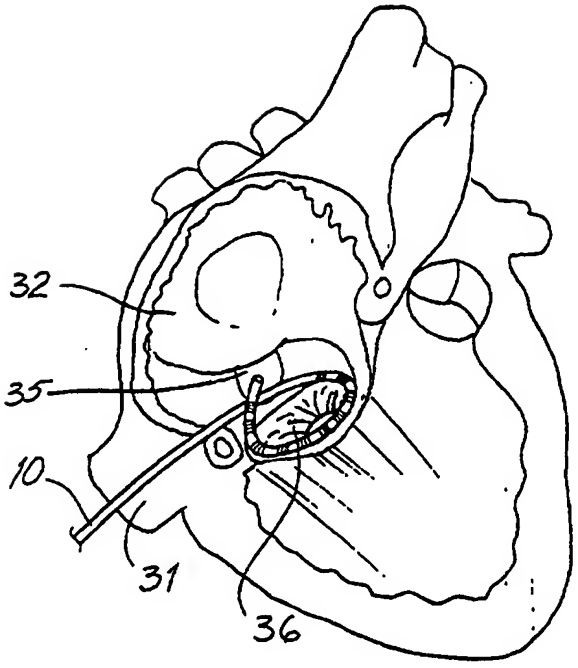


FIG. 7



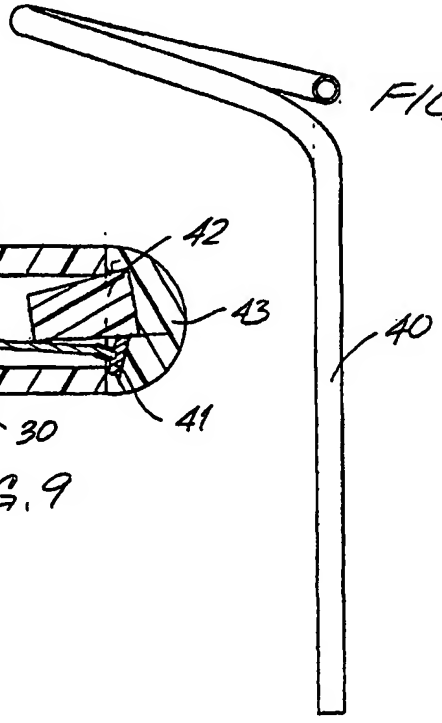


FIG. 8

FIG. 9